Fate of N in a small reservoir: Insights from sensors & spatial sampling in Mill Pond, Durham NH

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Motivation

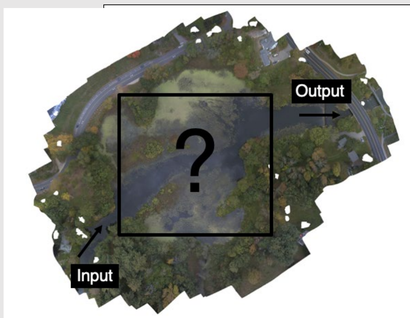
Excess aquatic nitrate (NO_3^-) leads to estuarine eutrophication and impairment

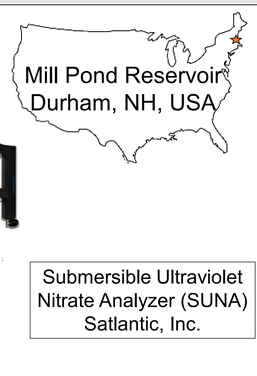
Reservoirs can attenuate nitrate, but questions remain regarding other nitrogen forms and response to storms

Small, coastal reservoirs are understudied, and may take on wetland characteristics as they fill in, leading to both spatial and temporal heterogeneity that affect N removal capacity

Integrating fixed-site sensor data at the inputs and outputs, and synoptic measurements within the reservoir is a powerful method for understanding biogeochemical patterns.

Conceptual design and methods



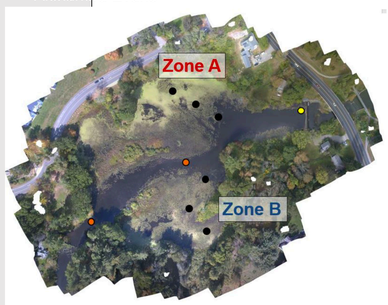


Submersible Ultraviolet Nitrate Analyzer (SUNA) Satlantic, Inc.

Area=.03 km^2

High-frequency mass balance approach captures nitrate concentration in a range of flow conditions

Orthomosaic images made by Alexandra Evans



NO_3^-

DON

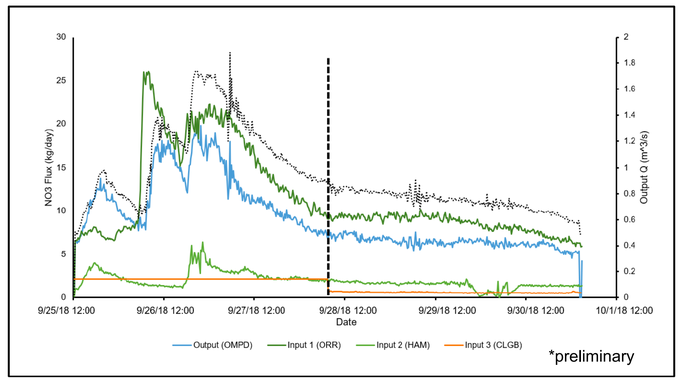
N_2O

N_2:Ar

D.O.

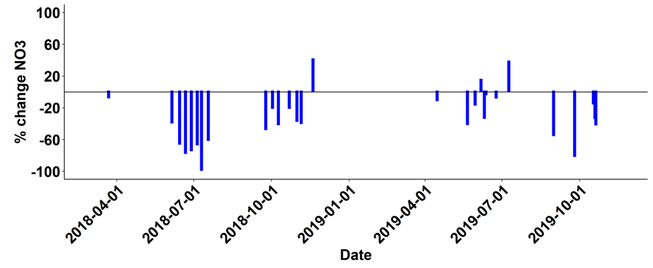
Synoptic sampling of solutes and dissolved gases involved in nitrogen processing captures biogeochemical dynamics

Reservoir is a nitrate **SINK**, including during storm events, but not for TDN

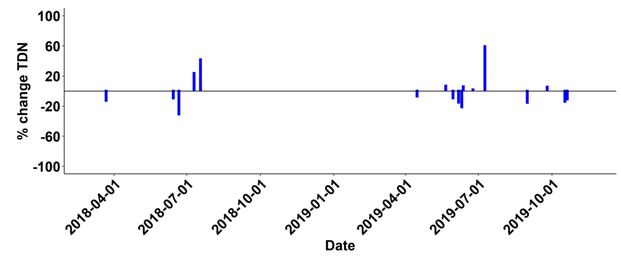


During storm: 40% NO3 retention

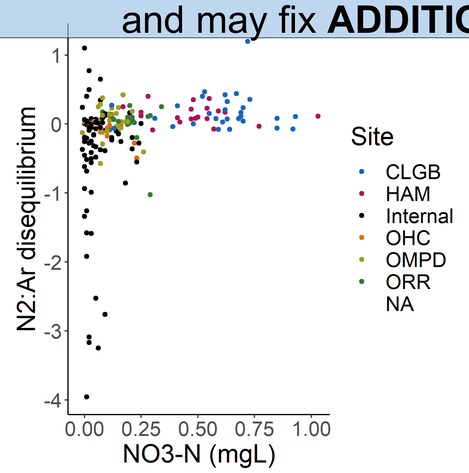
During baseflow: 32% NO3 retention



However, it is also tends to be a SOURCE for dissolved organic nitrogen, so that for TDN, there is little removal



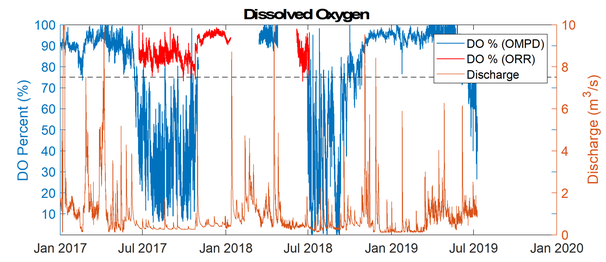
Reservoir **ASSIMILATES** nitrate, does not denitrify, and may fix **ADDITIONAL** nitrogen



There is little evidence that nitrate is permanently removed via denitrification.

Rather, N2:Ar tends to be undersaturated for N2 in the reservoir, suggesting N fixation is occurring.

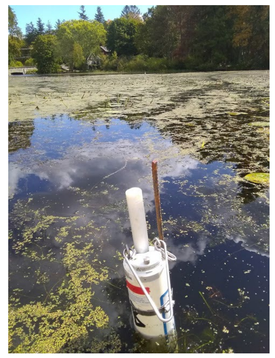
Low dissolved oxygen in the reservoir indicates poor water quality, yet little evidence of denitrification



Integration of sensor and spatial data

Reservoirs are not always nitrogen sinks and may at times be sources of NEW nitrogen

Sensors capture temporal variation, while synoptic sampling captures spatial variation.



Conclusions

Removal of Mill Pond dam is unlikely lead to an increase in nitrogen loading to the Great Bay

Removal of Mill Pond will lead to different types of nitrogen reaching Great Bay.

- Less nitrate, but more dissolved organic nitrogen
- Because this DON was produced in the reservoir, it is likely to be reactive (labile) when it enters Great Bay

Acknowledgements

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