Developing a Lake-Specific DOC Correction Factor for Nitrate Determination with UV-Vis Spectrophotometry

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Introduction

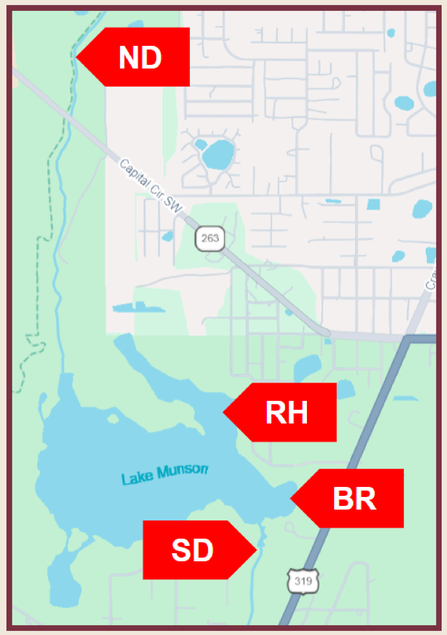
- Excess amounts of nutrients like nitrate and phosphate cause eutrophication in lakes, creating algal blooms that destroy aquatic ecosystems by using up oxygen and producing toxins (Leon County Water, 2025).
- Eutrophication is a major problem in Florida. Lake Munson in Tallahassee, FL, has a history of severe pollution and recurring algal blooms (Leon County Water, 2025).
- UV-Vis spectrophotometry can measure nitrate concentrations in lakes, but dissolved organic carbon (DOC) interferes because it absorbs at the same wavelength as nitrate (Edwards et al., 2001).
- The general correction equation for nitrate absorbance, $A_{NO3\text{-}N} = A_{220} - 2(A_{275})$, cannot account for high levels of DOC (Silva et al., 2024).
- Developing a DOC correction factor specific to Lake Munson can provide quick, precise, and cost-effective nitrate monitoring to aid state efforts in managing water quality.
- To obtain a specific DOC correction factor for Lake Munson, methods from Edwards et al. (2001) were used alongside broad sampling of Lake Munson.

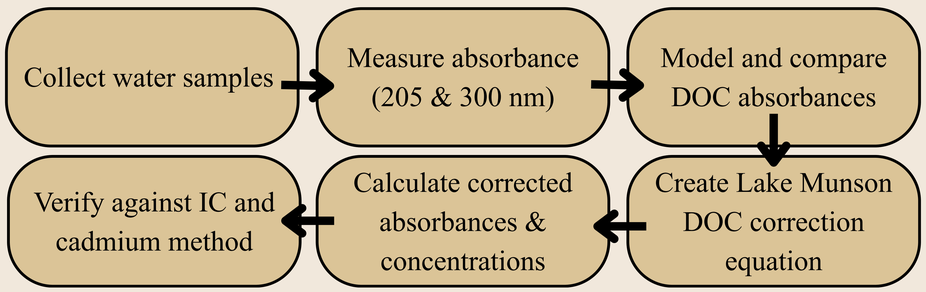
Methods

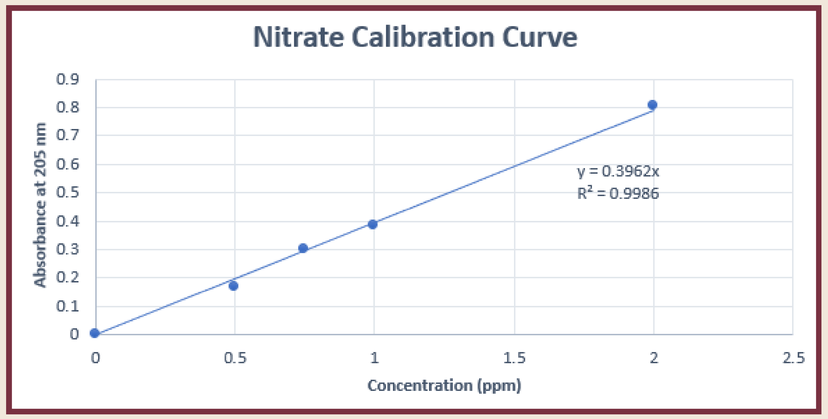
- Surface water samples were collected from four sites on Lake Munson: North Dam, South Dam, Boat Ramp, and Rabbit's Head.
- Samples were analyzed with a Cary 60 UV-Vis spectrophotometer. Absorbance was recorded at 205 nm (nitrate wavelength) and 300 nm (DOC reference wavelength).
- Potassium hydrogen phthalate (KHP) standards were prepared to model DOC. Absorbances at both wavelengths were measured to create a DOC-only calibration curve.
- The relationship between KHP absorbance at 205 nm v. 300 nm was graphed in Excel and used to determine the DOC correction factor (R).
- Corrected nitrate absorbance for lake samples was calculated using:

$$\mathbf{A_{NO3\text{-}N} = A_{205} - RA_{300}}$$

- A nitrate calibration curve was created from a standard solution and blank-corrected. Corrected absorbance values were used to calculate nitrate concentrations.
- Corrected UV-Vis nitrate concentrations were validated against direct measurements from ion chromatography (IC) and the colorimetric cadmium reduction method.







Results

- This project is ongoing. Next steps involve construction of the DOC model calibration curve, determination of the correction factor, then calculation of the nitrate concentrations.
- Nitrate calibration curve showed strong linearity ($R^2 = 0.9986$), indicating high accuracy for determining nitrate concentrations between 0 - 2 ppm.
- Cadmium reduction and IC analysis of lake samples directly measured nitrate concentrations at each Lake Munson site, averaging at 0.22 ppm NO_3-N.

Conclusions

- Future work will involve additional lake sampling and a comparison between nitrate concentrations calculated from the general and Lake Munson correction equations.
- Due to UV-Vis spectrophotometry's low cost and high sample processing speed, obtaining a specific DOC correction value for Lake Munson enables reliable routine nitrate monitoring.
- Enhanced nitrate monitoring will be invaluable to supporting efforts to improve water quality and stop algal blooms, which betters the environment and public health.
- These methods could be used to provide a similar framework for DOC determination in other lakes facing eutrophication.

References

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