

# Indications of Anthropogenic-Derived Nutrient Loading

## Localized Concentrations of $^{15}\text{N}$ Isotopes in Song Lake

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2014 Limnology Practicum

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### Background

- Song Lake is a privately owned lake located in Tully, NY – part of Central New York's kettle lake district
- Anthropogenic nitrogen input, coupled with the introduction of grass carp (to control macrophyte populations), may contribute to the large algal blooms experienced by Song Lake
- Nitrogen-based nutrients found in septic waste have high concentrations of the  $^{15}\text{N}$  isotope, consequently organisms found where seepage occurs may have higher  $^{15}\text{N}/^{14}\text{N}$  ratios in their tissue than organisms far-removed from the discharge<sup>1</sup>
- Monitoring of Song Lake has shown that certain areas in particular are more susceptible to and see larger algal blooms
- It is likely that these sites are found in close proximity to areas where discharge from the leaking septic tanks seeps into the lake and introduces nutrients
- **By looking at  $^{15}\text{N}/^{14}\text{N}$  ratios of periphyton and gastropods at sites of high (western shore), moderate (eastern shore), and low (island) human population density we aim to determine whether human population density is linked to nitrogen input**

### Hypotheses

- The  $^{15}\text{N}/^{14}\text{N}$  ratio will be highest for periphyton in areas of high human population density
- The  $^{15}\text{N}/^{14}\text{N}$  ratio will be highest for gastropod tissues in areas of high human population density
- Substrate periphyton density will be greatest in areas of high human population density

### Methods

- 3 sample sites – western shore, eastern shore, & island (Figure 1)
- Gastropods collected at each site using a D-net
- Periphyton collected from 47 cm<sup>2</sup> area of substrate
- $^{15}\text{N}/^{14}\text{N}$  ratios of gastropod and periphyton samples measured with a mass spectrometer
- R was used to perform ANOVA and Tukey's tests in order to determine significant difference in isotope signatures
- Isotope signatures compared to periphyton densities (used as an approximation for primary productivity)

### Results

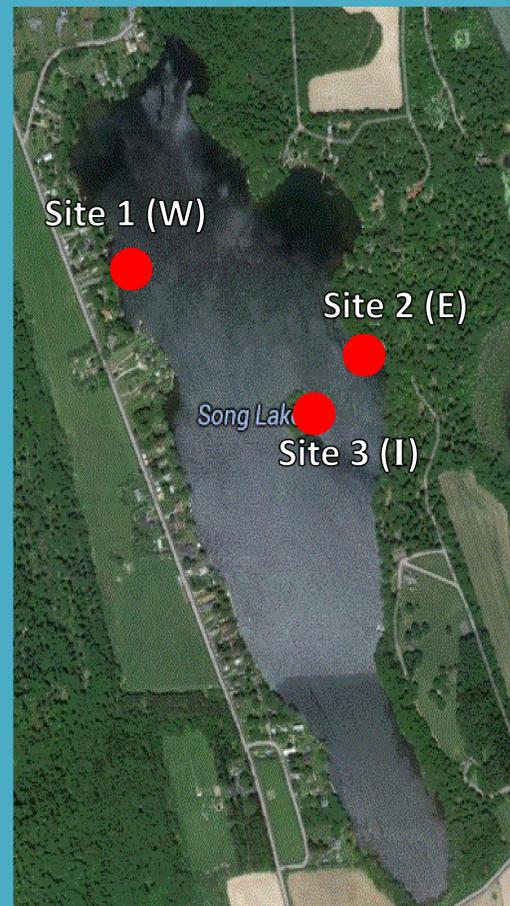


Figure 1. Sample site locations, Song Lake

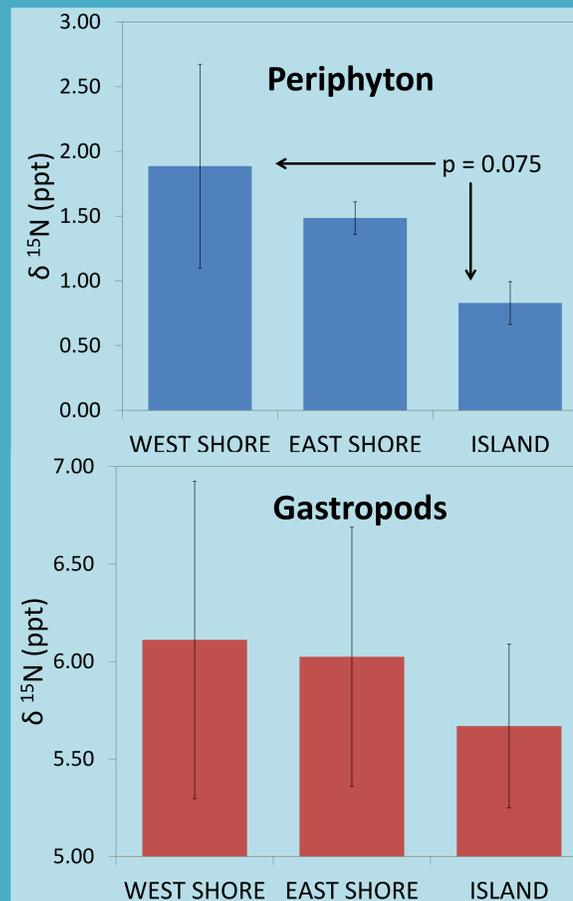


Figure 2. Mean  $^{15}\text{N}$  signatures  $\pm 1$  S.D. of periphyton and gastropod tissue at 3 sites

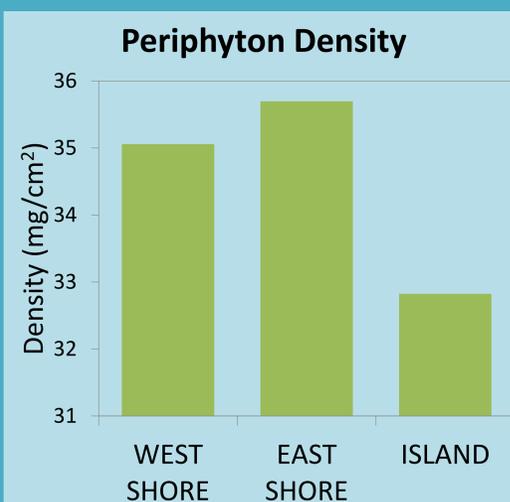


Figure 3. Periphyton biomass densities at 3 sites

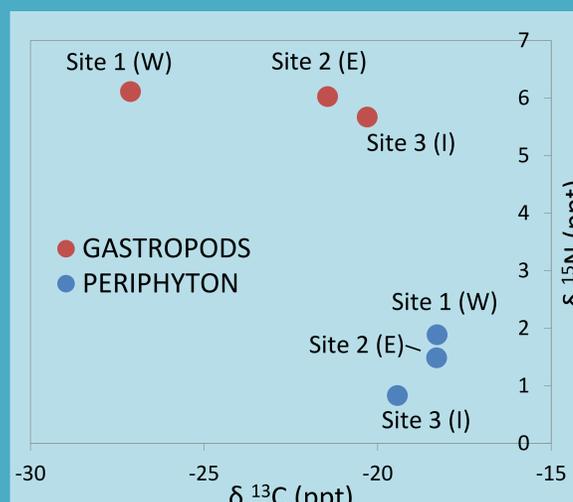


Figure 4. Mean  $^{13}\text{C}$  and  $^{15}\text{N}$  values of gastropods and periphyton at each sample sites.  $^{15}\text{N}$  values normally increase 3-5 ppt per trophic level;  $^{13}\text{C}$  values normally increase 0-1 ppt per trophic level

### Discussion

The  $^{15}\text{N}/^{14}\text{N}$  ratio of periphyton from the western site was higher than that of the island site (Figure 2), despite a small sample size (limited by cost). This supports our hypothesis that periphyton would have a higher  $^{15}\text{N}$  ratio at sites of high human population density. It is possible that this could be a result of seepage from septic tanks, especially in light of the fact that the property owners on the lake have limited their use of fertilizers around their homes. Greater densities of periphyton in closer proximities to the shoreline support this (Figure 3).

The ratios of  $^{15}\text{N}$  in gastropod tissue were not found to be significantly different between any of the sites. Gastropods appear to exhibit the same trend as periphyton, but the lack of statistical significance was due to higher variation in the sample values. This variation may be due to greater than anticipated movement of gastropods, resulting in foraging on multiple sources of periphyton or food sources other than periphyton such as macrophyte detritus. (Figure 4).

Larger sample sizes may show the hypothesized differences in  $^{15}\text{N}$  ratios of gastropods.

### Implications & Conclusions

- Our data suggest that proximity to lakeside residences may correlate with nitrogen input and consequently local eutrophication and algal blooms; trends were more pronounced at lower trophic levels
- Localized efforts to reduce nutrient input may improve overall water quality
- It is recommended that the property owners association attempt to identify point sources, such as leaking septic tanks, in order to address issues of nutrient input

### References

<sup>1</sup>Tamse, S., Mozetic, P., France, J., & Ogrinc, N. (2014). Stable isotopes as a tool for nitrogen source identification and cycling in the Gulf of Trieste (Northern Adriatic). *Continental Shelf Research*, 91, 145-157. doi:10.1016/j.csr.2014.09.009

### Acknowledgments

We would like to thank Kim Schulz, Ben Amos, Erik Hazelton, Ian Kinney, Emily Landers, the Song Lake Property Owners Association, the Grillo family, and the Cornell University Stable Isotope laboratory for making this project possible