Ian Yue
The Ecosystems Center at the Marine Biological Laboratory, Wheaton College
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Revised Title: Tracing anthropogenic nitrogen inputs into Cape Cod coastal plain ponds using stable isotopes, nutrient analysis, and water budget modeling

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Revised Abstract: Cape Cod houses one of the most concentrated assemblages of coastal plain ponds in the U.S. These naturally oligotrophic freshwater ponds, formed on glacial outwash plains, are primarily driven by groundwater flow, causing seasonal and annual variations in pond water level. This results in changing species composition along pond shorelines with season, making these ecosystems important areas for conservation. A current threat to pond livelihood is increased nitrogen (N) loading into recharging aquifers, particularly from septic systems. The purpose of my study was to: (1) Quantify the rates at which N is being loaded in Cape Cod coastal plain ponds, (2) Determine the relative extent to which this N-loading can be attributed to anthropogenic sources, and (3) Examine how accurately an integrative model can predict N-loading.

I researched N-loading by measuring NH_4^+ and NO_3^- in the groundwater recharging six ponds on an urban-to-rural gradient using wellpoint surveys and colorimetric water nutrient analysis. By the ammonia diffusion method, I determined $\delta^{15}N$ values for the recharging groundwater, which were used as relative indicators of anthropogenic N-loading. Finally, I calculated annual water and N budgets for the ponds' relevant groundwater recharge zones, and utilized ArcGIS and municipal zoning maps to determine potential and actual N-loading. I constructed the water budget using an MBL model that estimated actual evapotranspiration and groundwater recharge. I built the N budget based on assumptions in N-loading and attenuation to pond seepage points made by Valiela et al. (Ecological Applications 7:358-380). I compared the wellpoint results to modeled expectations to evaluate the model's accuracy. This work is part of a collaborative project examining $\delta^{15}N$ in groundwater, pond water, sediments, and bordering vegetation to evaluate anthropogenic N-loading effects on ecosystems.