Nutrient Criteria Development for Sierra Nevada Lakes

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Atmospheric nitrogen (N) deposition is altering biogeochemical cycles and ecological processes in high-elevation aquatic ecosystems. A need for stricter standards based on measurable ecological effects has been identified as an important step towards their long-term protection. The purpose of our study is to develop nutrient criteria for high-elevation lakes in the Sierra Nevada and apply these criteria to synoptic surveys. The comparison to existing surveys yields information on the temporal and spatial extent of potentially nutrient-affected lakes in the Sierra Nevada spanning the past 20 years and allows us to assess regional effects of atmospheric N deposition.

We are developing nutrient criteria using a bioassay approach where we measured phytoplankton response to N additions. Experiments were conducted *in situ* at four lakes in the Sierra Nevada. Sixteen mesocosms were installed at each site and spiked to create a nitrogen gradient. Phytoplankton response to nutrient additions was measured as chlorophyll *a* and criteria estimated using dose response curves. The dose response curve approach has been successful in developing nutrient criteria for macroalgae in Florida springs and is an attractive approach as it can be used to quantitatively determine effective doses (e.g., 10, 50, 90% doses). The 10, 50, and 90% doses for nitrate in our initial experiments conducted in the early growing season (July) are 0.44, 1.1 (0.7 SD), and 2.6 µM, respectively. The 10, 50, and 90% doses for the late growing season (September) are 0.89, 4.0 (7.5 SD), and 18 µM, respectively. In order to ensure we captured the full range of effective doses, the initial experiments had a wide nutrient gradient (0.0 – 50.0 µM). Our data show that the nutrient gradient went well above the 10 and 50% thresholds. The experiments were successful in narrowing down the range and estimating initial criteria. However, in order to address the large uncertainties associated with the estimates, we conducted additional experiments to refine the criteria and expanded our spatial sample size to 4 sites in order to investigate variability among lakes. Preliminary results show a measurable response at all four sites with some sites responding at concentrations lower than 1.0 µM. We are modeling these results to refine our criteria estimates and will be presenting these refined estimates along with application of the nutrient criteria to regional surveys, and an assessment of the dose response curve approach to estimating nutrient criteria for Sierra Nevada lakes.

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