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Seasonal Nutrient Limitation Patterns of Phytoplankton at Lake Eucha, Oklahoma

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Abstract Text:

Lake Eucha in Oklahoma, USA has come into sharp legal, political, and environmental focus because of a past lawsuit between the municipal drinking water supply (City of Tulsa, Oklahoma – plaintiffs) and several poultry integrators and one municipal wastewater treatment plant (defendants) in Arkansas. The purpose of this study was to evaluate the seasonal variation in algal nutrient limitation at Lake Eucha, and we focused on whether P and or N were limiting the growth of either reservoir phytoplankton. Nutrient availability was low (decreased concentrations) during Summer when the reservoir was stratified and nutrient availability was high (increased concentrations) during late Fall and Winter. Nutrient availability also varied spatially and was greater in the headwaters (i.e., riverine zone) compared to near the dam (i.e., lacustrine zone). Sestonic algal growth (measured indirectly via chl–a) varied seasonally and spatially, as typically observed in other regional reservoirs; sestonic chl–a concentrations were greatest in late Summer and in the riverine zone. The typical pattern would be phytoplankton are temperature limited during late Fall and Winter, P limited during Spring and early Summer and then shifting to N limitation in late Summer and early Fall. Thus, algal growth is likely limited by temperature, when nutrient availability is greatest following mixis, or turnover in this reservoir. However, this typical annual pattern in algal nutrient limitation can be disrupted if and when large storm events occur during early to mid Summer. These storm events provide an advective supply of nutrients, particularly NO3–N, to the epilimnion of a reservoir and increase nutrient availability to algae causing nutrient limitation pattern to shift. In fact, Lake Eucha experienced a rather large storm event one Summer which shifted the pattern to P limitation during Summer and to co–limitation during late Fall. Thus, seasonal fluctuation in nutrient transport from the catchment to the reservoir has a profound impact of the individual nutrient limiting algal growth in water column.

Impact Statement:

This project showed that watershed managers should not solely focus on the impacts from phosphorus transport to surface waters, but that nitrogen limitation of algal growth occurs seasonally in Ozark reservoirs.