Phytoplankton primary production and photosynthetic parameters in reservoirs along a gradient of watershed land use

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ABSTRACT: We investigated how watershed land use (a gradient of agricultural vs. forested land) relates to phytoplankton primary production (PPr) and photosynthetic parameters in 12 reservoirs in Ohio and examined spatial variation in these parameters. Shallow sites near stream inflows had higher light attenuation, total phosphorus (TP), chlorophyll, nonvolatile suspended solids (NVSS), light-saturated photosynthesis (P^B_m), and volumetric PPr than deeper sites near dam outflows, but areal PPr and the initial slope of the photosynthesis-irradiance curve (α^B) were not significantly different between sites. Mean mixed layer irradiance and the severity of light limitation did not differ between sites because shallower depths compensated for higher light attenuation at inflow sites. Watershed land use (percent agriculture) was only weakly (but significantly) related to mean annual PPr, TP, and chlorophyll, but there was a well-defined upper limit to the effect of land use on all three of these parameters. Multiple regression showed that inclusion of additional watershed factors (the ratio of watershed land area to reservoir volume and the ratio of cropland area to number of livestock) greatly increased the variance explained compared to land use alone. TP and chlorophyll were highly correlated with each other and with PPr. Comparison of our TP-chlorophyll, TP-PPr, and chlorophyll-PPr regressions with those of other studies suggests that reservoirs have lower PPr per unit TP than natural lakes, probably because of lower light intensity and higher concentrations of nonalgal P in reservoirs.