Do zooplankton contribute to an ultraviolet clear-water phase in lakes?

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ABSTRACT: Seasonal increases in the ultraviolet (UV) transparency of the surface waters of an oligotrophic lake in Pennsylvania suggest that clear-water phase (CWP) events similar to those previously observed for visible light also exist for the potentially damaging UV wavelengths. Seasonal increases in zooplankton grazers indicate that they play a role in these changes in UV that is similar to the role that zooplankton play in CWP events involving longer-wavelength visible or photosynthetically active radiation (PAR, 400-700 nm). The potential role of zooplankton and incident UV in generating UV CWP events was investigated with a set of in situ microcosm experiments that manipulated UV and zooplankton, and followed changes in particulate and dissolved absorbance in the UV (320 nm) and PAR wavelength ranges over an 8-d period in April. Nutrients were also manipulated independently to examine the potential role of nutrient regeneration by zooplankton grazing in altering water transparency. Photobleaching by incident solar UV led to a strong and significant decrease in dissolved UV and PAR absorbance. The presence of zooplankton grazers also significantly decreased dissolved UV absorbance but increased dissolved PAR absorbance. Neither zooplankton nor UV had any significant effects on or PAR absorbance by particulates. In contrast, nutrient additions significantly increased dissolv absorbance in both the UV and PAR wavelength ranges, indicating that regeneration of nutrient: by zooplankton offsets decreases in UV absorbance and enhances increases in PAR absorbance due to grazing. While photobleaching by UV radiation is likely to make a consistent strong contribution to UV CWP events in lakes, the net effects of zooplankton on UV transparency in a given lake will depend upon multiple factors including zooplankton density and a balance betwe the edibility and extent of nutrient limitation of the phytoplankton.