J. N. Am. Benthol. Soc., 2005, 24(2):246–255

Attenuation of ultraviolet radiation in streams of northern Michigan

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Abstract. We measured the attenuation of ultraviolet B (UVB) and ultraviolet A (UVA) radiation in 32 streams located within the Ontonagon River watershed on the Upper Peninsula of Michigan, USA. Attenuation coefficients (K_d) of UVB and UVA ranged widely among these streams, but generally translated into relatively shallow 1% transmission depths into the water column (2–45 cm for UVB and 6–103 cm for UVA). Both $K_{d\ UVB}$ and $K_{d\ UVA}$ were positively correlated with stream dissolved organic C concentration (DOC, range 2–35 mg C/L). Absorbance coefficients of dissolved matter (a_d) of UVB and UVA also were strongly correlated with DOC. $K_{d\ UVA}$ (but not $K_{d\ UVB}$) was weakly related to the concentration of particulate organic C and DOC molar absorptivity. DOC-specific $K_{d\ UVB}$ was, on average, higher in streams of our study compared to previously published values from lakes and wetlands. We developed a statistical model that predicts UVB flux to benthic organisms. The model incorporates information on water depth, DOC concentration, surface reflectance, and forest canopy cover. This stream-UVB model (SUM) predicts very low UVB flux to the benthic areas of most wetland and forested streams of this region during cloudless, midsummer days. Overall, our results suggest a low likelihood that stream organisms in this region are normally exposed to high levels of ultraviolet radiation because shading is provided by both stream DOC and forest canopy.

Key words: UV radiation, dissolved organic matter, forest canopy, river, benthos.