

Vertical mixing within the epilimnion modulates UVR-induced photoinhibition in tropical freshwater phytoplankton from southern China

VIRGINIA E. VILLAFANE,^{*,†} KUNSHAN GAO,^{*,‡} PING LI,^{*} GANG LI^{*} AND E. WALTER HELBLING^{*,†}

^{*}Marine Biology Institute, Shantou University, Shantou, Guangdong, 51 5063, China

[†]Estación de Fotobiología Playa Unión and Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Casilla de Correos N° 15 (9103) Rawson, Chubut, Argentina

[‡]State Key Laboratory of Freshwater Ecology and Biotechnology, Institute of Hydrobiology, The Chinese Academy of Sciences, Wuhan, Hubei, 430072, China

SUMMARY

1. The importance of vertical mixing in modulating the impact of UVR on phytoplankton photosynthesis was assessed in a tropical, shallow lake in southern China from late winter to mid-spring of 2005.
2. Daily cycles of fluorescence measurements (i.e. photosynthetic quantum yield, Y) were performed on both 'static' and *in situ* samples. Static samples were of surface water incubated at the surface of the lake under three radiation treatments – PAB (PAR + UVR, 280–700 nm), PA (PAR + UV-A, 320–700 nm) and P (PAR, 400–700 nm). *In situ* samples were collected every hour at three different depths – 0, 0.5 and 1 m.
3. The general daily pattern was of a significant decrease in Y from early morning towards noon, with partial recovery in the afternoon. Samples incubated under static conditions always had lower Y than those under *in situ* conditions at the same time of the day.
4. Under stratified conditions, no overall impact of UVR impact could be detected *in situ* when compared with the static samples. Further rapid vertical mixing not only counteracted the impact of UVR but also stimulated photosynthetic efficiency.
5. Based on these measurements of fluorescence, the mixing speed of cells moving within the epilimnion was estimated to range between 0.53 and 6.5 cm min⁻¹.
6. These data show that mixing is very important in modulating the photosynthetic response of phytoplankton exposed to natural radiation and, hence, strongly conditions the overall impact of UVR on aquatic ecosystems.

Keywords: mixing, photosynthesis, photosynthetically available radiation, phytoplankton, ultraviolet radiation

Correspondence: Virginia E. Villafañe, Estación de Fotobiología Playa Unión, Casilla de Correo No. 15, (9103) Rawson, Chubut, Argentina.
E-mail: virginia@efpu.org.ar

Permanent address: Estación de Fotobiología Playa Unión and Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Casilla de Correos N° 15 (9103) Rawson, Chubut, Argentina