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Perspectives and research on environmental effects of ultraviolet radiation

Ruben Sommaruga [Guest editor]

University of Innsbruck, Austria

Research on environmental effects of UV radiation (UVR) in terrestrial and aquatic ecosystems was largely stimulated by the discovery of the ozone depletion over Antarctica, the so-called 'ozone hole', and was primarily concerned with UV-B radiation (280–315 nm). However, it was rapidly recognized that many of the effects of solar UVR were caused also by wavelengths in the UV-A range (315–400 nm) that are not affected by changes in stratospheric ozone. In addition, it was obvious that just natural levels of incident UVR (*i.e.* in the absence of ozone reduction) were sufficient to cause significant negative effects and also unexpected positive feedbacks such as, for example, between photodegradation of chromophoric dissolved organic matter (CDOM) and stimulation of bacterial growth.

Without doubt, the results obtained during the last three decades of research on UVR have made the scientific community aware of the multiple interactions of this region of the solar spectrum and abiotic/biotic components of aquatic and terrestrial ecosystems. In particular, those results have highlighted the need to take into account UVR as another relevant environmental factor in ecological studies. Thus, for example, field experiments done under typical "*in situ*" conditions, but *in the dark*, need to be revised to include the effects of UVR.

When considering a future scenario where levels of stratospheric ozone may eventually recover, it is important to mention that other global changes such as, for example, climate warming, are taking place and will have synergistic or antagonistic effects with UVR. Thus, for example, climate warming is inducing rapid changes in water transparency in many regions of the world as a consequence of changes in the supply of CDOM concentrations, and, most importantly, those changes affect the whole UV range. Consequently, one of the present challenges is to understand how UVR interacts with other threats such as climate warming, changes in CDOM concentration, elevated CO₂ levels (*e.g.* acidification of the oceans), as well as nutrient limitation and enrichment.

The reports of the United Environmental Program (UNEP), particularly the last one on "Environmental effects of ozone depletion and its interactions with climate change",¹ have been particularly relevant in resuming the advances in this area. This issue of *Photochemical & Photobiological Sciences* contains a series of articles that reflect the most recent advances on several specific aspects of environmental UVR in marine, freshwater, and terrestrial ecosystems. There are seven Perspectives on topics such as the use of different proxies for reconstructing solar UV and stratospheric ozone levels (Rozema *et al.*, DOI: 10.1039/b904515e), the effects of UVR on coral reef organisms (Banaszak and Lesser, DOI: 10.1039/b902763g), the interactive effects between UVR and other stress factors (nutrient limitation, elevated CO₂ levels) on marine phytoplankton (Beardall *et al.*, DOI: 10.1039/b9pp00034h), the effects of UVR on the productivity and composition of freshwater phytoplankton (Harrison and Smith, DOI: 10.1039/b902604e), the UVR effect on the xanthophyll cycle in marine phytoplankton (van de Poll and Buma, DOI: 10.1039/b904501e), the effects of UVR on pigmentation, photoenzymatic repair, behaviour, and community ecology of zooplankton (Hansson and Hylander, DOI: 10.1039/b908825c), and the importance of UVR and thermal structure for organisms living in alpine and subalpine

lakes (Rose *et al.*, DOI: 10.1039/b905616e). In addition, four research articles round up this themed issue and include the following topics: the photosynthetic response of Arctic kelp zoospores exposed to radiation and thermal stress (Roleda, DOI: 10.1039/b901098j), the resistance to UVB of the marine bacterium *Photobacterium angustum* and the role of photolyase (Matallana-Surget *et al.*, DOI: 10.1039/b902715g), the quality of UVR exposure for different biological systems along a latitudinal gradient (Vernet *et al.*, DOI: 10.1039/b904540f), and finally a study documenting rapid shifts in bacterial community composition caused by CDOM photoalteration (Piccini *et al.*, DOI: 10.1039/b905040j).

The reason for the apparent dominance of perspectives and research articles related to aquatic ecosystems is partially attributed to my 'aquatic' bias and should not be regarded as one area having more importance than the other.

Reference

1. Photochem. Photobiol. Sci. 2007; 6(3) themed issue on the 2006 UNEP assessment on environmental effects of ozone depletion and its interactions with climate change.