Symposium-in-Print: UV Effects in Aquatic and Terrestrial Environments†
Introduction

Patrick J. Neale*, E. Walter Helbling2 and Thomas A. Day3
1Smithsonian Environmental Research Center, Edgewater, MD
2Estación de Fotobiología Playa Unión, Chubut, Argentina
3Department of Plant Biology, Arizona State University, Tempe, AZ

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Solar ultraviolet radiation (UVR) plays a variety of roles in aquatic and terrestrial environments and an increasing realization of the diversity of UVR effects in the environment has sustained a continued interest in the subject. The latest research on this theme was highlighted at the 33rd meeting of the American Society of Photobiology in San Juan, Puerto Rico (July 2006) in a symposium on “UV Effects in Aquatic and Terrestrial Environments.” In this Symposium-in-Print (SIP), selected contributions from the meeting are presented in 10 research articles and one review. These presentations span the full range of present-day research in UV environmental photobiology, reflecting a diversity of environments, organisms and mechanisms of action. Probably the greatest breadth in this group of articles is the size scale of the object under study, which spans many orders of magnitude from molecules in solution, to picoplankton, motile unicells and multicellular microorganisms, and finally to macro algae, corals and terrestrial plants. Of course, the smallest scale is the scale (wavelength) of the UV photons themselves. In the following overview of the SIP, and ensuing order of articles, we proceed along the dimension of size.

Starting at the photon scale is the report by Parisi et al. (1), who employed a UVA dosimeter to examine the solar UV transmission through different types and thicknesses of glass and also examined the influence of solar zenith angle on transmission. Transmission depended on glass type and thickness, and the influence of zenith angle varied with glass type and thickness. Their contribution will have interest for researchers in a variety of environments with its demonstration of the application of a UVA dosimeter, as there are few options for environmental UVA dosimetry compared with UVB dosimetry.

Advancing to the molecular scale, Tzortziou et al. (2) examined the photochemical degradation (photobleaching) of colored dissolved organic matter (CDOM) in the Rhode River estuary by exposure to solar radiation. The authors show that depending on UVR spectral quality, solar exposure can either enhance or decrease the CDOM absorption spectral slope. They also derived a spectral model to describe the effects of solar radiation on CDOM optical quality. Their results help to explain the contrasting results from previous studies, in which both increases and decreases in slope have been reported.

Several articles in the SIP address UV effects on the unicellular algae, or phytoplankton. The paper of Agustí and Llabrés (3) examined the response of communities of pico-phytoplankton (cell size < 2 μm) to underwater solar radiation in the equatorial, tropical and temperate Central Atlantic Ocean. The authors showed that the cyanobacteria, *Synechococcus* and eukaryotes were more resistant than *Prochlorococcus*. The latter genus is often found in deep waters, whereas at the surface it had high mortality rates even after short-term exposure to solar radiation (i.e. 30 min). In the South China Sea, Gao et al. (4) found that solar UV exposure can have both positive and negative effects on photosynthetic rates of phytoplankton depending on the size and recent light history of the assemblage. Two articles by Richter et al. examine how motile phytoplankton change their patterns of movement during UV exposure. In the first article (5), patterns of diurnal vertical migration and motility were compared for representatives of two groups—flagellated microalgae, Chlorophytes (*Dunaliella salina* and *Tetraselmis suecica*), and dinoflagellates (*Gymnodinium chlorophorum*). The chlorophytes exhibited the most extreme responses, either nonresponsive (*T. suecica*) or very sensitive (*D. salina*), while the dinoflagellates had an intermediate response. Such differences in motility patterns can affect species composition in surface waters. In the second article, Richter (with a different set of co-authors, [6]) studied the motility of the auxotroph, *Euglena gracilis*, and found that excessive irradiance changes the direction of net movement from upward to downward. This acts as an “escape mechanism” enabling movement of these organisms away from high irradiance even if their photoreceptors get “blinded” near the water surface.

Change in motility in response to UV radiation is also the theme as we move to the millimeter scale of the freshwater crustacean, *Daphnia spinulata*. Many members of this genus are known to change vertical migration patterns in response to UVR, but Goncalves et al. (7) found that other factors appeared to outweigh UVR in a shallow, strongly wind-stirred, Patagonian lagoon.

On the centimeter–meter scale we have coral reefs—macrostructures resulting from the activity of the microscopic symbiosis of a cnidarian and dinoflagellates in the genus *Symbiodinium* (also known as zooxanthellae). The paper of Banaszak (8) presents an optimized method to extract DNA...
from a coral host and its symbiont in order to assess the impact of solar radiation on the DNA of both the coral (*Porites astreoides*) and its symbiont. The optimization of the method also aims to prevent cross contamination of the DNA between host and symbiont. Torres (9) transplanted a threatened Caribbean coral (*Acropora cervicornis*) from a depth of 20–1 m, where they were exposed to substantially higher UV levels. Concentrations of UV screening compounds (MAAs) increased in these transplanted colonies, and zooxanthellae densities were not affected, suggesting appreciable acclimation to the higher UV levels of the shallower water. Nonetheless, concentrations of photosynthetic pigments and growth rates were reduced in these colonies, implying that the skeletal structure was damaged, possibly from a reduction in photosynthetic capacity of their symbionts.

Moving closer to shore, Roleda *et al.* (10) provide a comprehensive review of UV effects on different life stages of marine macroalgae, which span the millimeter to meter size scales. They propose that UVR can determine the upper depth distribution limit of macroalgae on the shore. A combination of biogeographic and experimental data are described that suggest this occurs due to the high sensitivity of early life stages.

Finally, emerging into the full solar exposure of agricultural fields, Sullivan *et al.* (11) examined the day-to-day variability in levels of UV-B screening compounds in leaves of barley and soybean seedlings and found that levels were significantly correlated with solar UV-B irradiance. In these species, it appears that UV-B dose during the early days of leaf development imparts a substantial influence on subsequent screening compound concentrations, although other factors appear to be involved as well.

We hope that this diverse array of articles offers something for everyone in the environmental photobiology and UV effects readership of *Photochemistry and Photobiology*. We thank all the authors for submitting their manuscripts in a timely manner and especially for carefully attending to peer reviewers’ and editors’ comments in the subsequent revision process.

REFERENCES