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EDITORIAL

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The stratospheric ozone layer is becoming thinner, with an associated increase in ultraviolet (UV)-B radiation at the earth's surface. This had been recognized as a serious climate problem by the end of the twentieth century, and is expected to be considerably more worrying in this new millennium. One particular result of this is the growing number of medical, physical, biochemical and ecophysiological studies on the effects on the biosphere of an elevated UV-B component in global solar radiation. UV-B penetrates sea water to relatively small depths, especially in productive bodies of water with a high particulate content. For instance, the 1% penetration depth for UV-B has been found to be 1 m off Helgoland (see Dring et al., this issue) and 0.13–0.31 m in coastal areas of the Baltic Sea (see Schubert et al., this issue). There has therefore been a tendency to regard marine aquatic organisms as only slightly affected by UV. As a result, there is a clear deficit of publications about the action of UV on the marine flora and fauna, and the available information about their UV-specific risk and adaptation potential shows substantial gaps.

This situation was a prime consideration in the planning and execution of the project "UV-Strahlung und marine Organismen" (UV Radiation and Marine Organisms; UV-MAOR), financed by the German Federal Ministry for Education and Research (BMBF) and carried out in the period 1994–2000 by four research groups comprising both botanists and zoologists. The central subject was the marine UV climate in shallow water, or tidal zones, of the Baltic Sea and North Sea, and its effects on the organisms living in these regions and hence exposed to solar radiation. All participants in the UV-MAOR project are most grateful to the BMBF in Bonn and in particular to the administrator of the project, Dr. Irmisch, of the BEO Rostock-Warnemünde, for all that was done to advance the project and attend to our needs.

Specifically, the research was concentrated on phytoplankton (research group of Prof. Dr. H. Schubert, University of Rostock, now University of Greifswald), UV-protection strategies of zooplankton (research group of Prof. Dr. R. -J. Paul, University of Münster), UV effects on macrophytobenthos (research group of Prof. Dr. K. Lüning, Biologische Anstalt Helgoland), and UV-induced reactions of macrozoobenthic sea anemones (research group of Prof. Dr. W. Westheide, University of Osnabrück). The study comprised laboratory, semi-field and field observations and experiments. Contributions from these four groups are at the core of this special issue. Three additional papers come from two other groups in Germany active in the field of UV research on aquatic organisms: those of Prof. Dr. D.-P. Häder, University of Erlangen and Dr. H. von Westernhagen/Dr. H. Tüg, Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven.

With a total of nine original papers, on relatively few organisms investigated with various methods and in some cases from different viewpoints, this issue is not intended to provide a comprehensive review of the UV risk to European marine coastal ecosystems. However, the abundance of data in these reports does certainly provide a basis for evaluating the present and future conditions with reference to increased UV-B exposure. For example, the UV-radiation measurements below the sea surface off Helgoland taken over a period of 5 years by Dring et al. constitute a valuable database for various attempts to model biological effects of natural UV radiation on marine organisms in the North Sea area. So do the underwater light-climate data for the southern coast of the Baltic Sea presented by Schubert et al. They are correlated with the findings of a major reduction of irradiance levels in the water column of this area in the mesocosm experiments by Forster and Schubert showing that planktonic communities in shallow depths of the brackish estuary in the Baltic Sea are protected from UV-B irradiation by high concentrations of chromopho-

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ric, dissolved organic matter. Häder et al. present the 1998 UV-B, UV-A and PAR data obtained with the European Light Dosimeter Network, which – with few exceptions – show the expected strong latitudinal dependence from northern Sweden to the Canary Islands. UV-B exposure experiments on pelagic fish embryos produced only sublethal damage, from which Dethlefsen et al. concluded that under the present general weather conditions the development of North Sea spring-spawning fish is not endangered. Experimental irradiation approximating worst-case conditions, however, revealed increased mortality, loss of positive buoyancy and affected ventilation rates in eggs, larval and juvenile stages of plaice (Steeger et al.). Effective photosynthetic quantum yield decreased significantly in two rhodophyte and two phaeophyte macroalgae following brief exposure to solar radiation (Häder et al.). A mesocosm experiment with the macroalga *Dictyota dichotoma* exposed to the full solar spectrum revealed significantly decreased growth rates, but generally no structural defects (Kuhlenkamp et al.). UV irradiation simulating the UV component of the solar spectrum also was not lethal to sea anemones (*Metridium senile*) under long-term (40 months) laboratory conditions, but their body mass fell significantly, they positioned themselves so as to be less exposed, and they all changed colour from white to brown (Westholt et al.).

In general, then, these findings leave no room for doubt that a future increase of UV-B in solar radiation would definitely be a threat to marine organisms that live in exposed regions: in the tidal zone or near the sea surface. Under the present climatic conditions, however, marine organisms appear not to be directly endangered. A fascinating result of these and related publications of the participating research groups is that possible means of protecting against UV stress, and the adaptive potential of some species to avoid such stress, are either directly demonstrable or at least strongly suggested. Hence there is an excellent opportunity for the establishment of UV- and UV-B-specific indicator organisms – as is also indicated by the research project as a whole. To find better means of identifying these organisms should be a central goal of future UV research in the marine realm.