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Effects of solar radiation on bacterioplankton production in the upwelling system off central-southern Chile

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ABSTRACT: The influence of solar radiation on bacterial secondary production (BSP), bacterial growth efficiency (BGE), and growth rates (μ) in upwelling zones of the Humboldt Current System (HCS) is not yet understood. Here we assessed the impact of solar radiation, with special focus on ultraviolet radiation (UVR, 280 to 400 nm) on 2 natural bacterioplankton assemblages with different light history coming from surface waters (0.5 m) and subsurface waters (80 m) off central-southern Chile (36° S). The samples were incubated under ambient irradiance for 4 to 11 h and exposed to 3 spectral radiation treatments: photosynthetically active radiation (PAR, 400 to 700 nm), PAR+UV-A (320 to 700 nm), and PAR+UVR (280, to 700 nm). BSP was estimated by ^{14}C-leucine (protein synthesis) and [methyl-^{3}H]-thymidine (DNA synthesis) uptake. Both bacterioplankton assemblages showed significant ($p < 0.05$) inhibition of BSP, BGE, and μ rates when exposed to PAR radiation; in contrast, responses to UV radiation were more variable. At noon, BSP inhibition was 49 to 53% (PAR), 13 to 30% (UV-A), and 5 to 14% (UV-B) for both assemblages. At sunset, in surface assemblages, protein and DNA synthesis were more limited by UV-A than by UV-B, whereas protein synthesis in the subsurface assemblage was more inhibited by UV-B than by UV-A. The same inhibition patterns were found for BGE and μ, especially with regard to protein synthesis. The daily inhibition of BSP, BGE, and μ in both assemblages was mainly a function of PAR followed by UV-A and UV-B. Our results suggest that solar radiation could play an important role in modulating bacterioplankton dynamics (especially protein synthesis) during active upwelling periods in the HCS.

KEY WORDS: UV effects · PAR effects · Bacterioplankton · Growth rates · Upwelling · Humboldt Current System

INTRODUCTION

Since the discovery of the Antarctic ozone 'hole' there has been renewed interest in the effect of solar radiation on marine communities. The solar spectrum that reaches the Earth's surface comprises photosynthetically active radiation (PAR, 400 to 700 nm) and ultraviolet radiation (UVR, 280 to 400 nm; Díaz et al. 2000). UVR is further divided into UV-A (320 to 400 nm) and UV-B (280 to 320 nm). Although there is consensus that increased amounts of UVR are potentially damaging to the biosphere, reports on the effect that UVR has on marine communities range from no net effects (Gustafson et al. 2000) to severe conse-

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