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Productivity cycles in the coastal upwelling area off Concepción: The importance of diatoms and bacterioplankton in the organic carbon flux

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Abstract

Recurrent coastal upwelling is recognized as one of the main factors promoting the exceptionally high productivity of the Humboldt Current System. Herein, we study time series data of gross primary production (2003–2006) and its fluctuation in relation to seasonal changes in the light and nutrient field of the Concepción upwelling ecosystem. Concurrent measurements of gross primary production, community respiration, bacterial secondary production, and sedimentation rates allowed a characterization of the main carbon fluxes and pathways in the study area. The integrated values of gross primary production were higher during the upwelling period (>1 g C m^{-2} d^{-1}; October–April; that is, early spring to early austral fall). Seasonal changes in the system were also reflected in community respiration, organic matter sedimentation, and bacterial production rates, which varied along with the gross primary production. The significant correlation between gross primary production and community respiration (Spearman, $r = 0.7$; $p < 0.05$; $n = 18$) reflected an important degree of coupling between organic matter formation and its usage by the microplanktonic community during periods when gross primary production/community respiration were highly similar. Higher gross primary production values (>6 g C m^{-2} d^{-1}) were consistently associated with maximum biomass levels of *Skeletonema costatum* and *Thalassiosira subtilis*. We observed a positive correlation between gross primary production and the sedimentation of intact diatom cells (Spearman, $r = 0.5$, $p < 0.05$, $n = 17$). Our data suggest that, in the Concepción upwelling ecosystem, bacteria utilize an important fraction of the gross primary production. If our interpretations are correct, they leave unanswered the question of how the system supports the extremely high fish biomass levels, therein pointing out the system's limited capacity to buffer the evasion of CO_2 following upwelling.

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