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Early spring bloom phytoplankton-nutrient dynamics at the Celtic Sea Shelf Edge

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Abstract

Phytoplankton production was measured at the shelf edge region of the Celtic Sea in April/May 1994 at the beginning of the spring bloom. Size fractionated ^{14}C uptake experiments showed that phytoplankton $>2\frac{1}{4}\text{m}$ dominated the bloom although, in the period immediately before the increase in phytoplankton biomass, picophytoplankton ($<2\frac{1}{4}\text{m}$) was responsible for up to 42% of the production; in these late winter conditions, chlorophyll concentrations were generally $<0.7\frac{1}{4}\text{g}\text{ l}^{-1}$ and primary production was ca. $70\text{ mmol C m}^{-2}\text{ d}^{-1}$. As the spring bloom developed, phytoplankton production rates of $120\text{ mmol C m}^{-2}\text{ d}^{-1}$ were measured. Chlorophyll concentration increased to $>2\frac{1}{4}\text{g}\text{ l}^{-1}$ as a result of growth of larger phytoplankton, including diatoms, with large numbers of *Nitzschia*, *Thalassionema* and *Chaetoceros* dominating the assemblage. Picophytoplankton production declined as the spring bloom progressed. Nutrient concentrations were not depleted during the sampling period, and

NO_3^- concentrations were $>6 \frac{1}{4} \text{mol l}^{-1}$. Nutrient assimilation rates were measured at the same time as primary production was estimated. Before the development of any substantial phytoplankton biomass, the uptake rates for ammonium and nitrate were very similar, with f -ratios ranging from 0.5 to 0.6. Assimilation of ammonium remained relatively constant after the onset of stratification and bloom development, but nitrate uptake increased by a factor of 2 or more, resulting in f -ratios >0.8 . There was significant phosphate uptake in the dark, which was generally ca. 50% of the rate in the light. The C : N : P assimilation ratios changed as the bloom developed; in the pre-bloom situation, when small phytoplankton cells dominated the assemblage, the C : N assimilation ratio was variable, with some stations having ratios less than (ca. 2.5), and some higher than (ca. 9), the Redfield ratio. The most actively growing assemblages had N : P ratios close to the Redfield ratio, but the C : N ratios were consistently lower. New production was found to be closely correlated with the size of the species making up the phytoplankton assemblage, and high f ratios were measured when larger phytoplankton dominated the assemblage.



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