Coulometric carbon-based respiration rates and estimates of bacterioplankton growth efficiencies in Massachusetts Bay

Toolan, Tara

Limnol. Oceanogr., 46(6), 2001, 1298-1308 | DOI: 10.4319/lo.2001.46.6.1298

ABSTRACT: Heterotrophic bacterioplankton production rates have been measured in many aquatic ecosystems over the last two decades, whereas measurements of bacterioplankton respiration rates have been scarce. This paper reports and discusses measurements of carbon-based plankton respiration rates made in a coastal ecosystem over an annual cycle. The coulometric technique was used to measure total inorganic carbon (TCO_2) production rates in 0.8- μm filtered and unfiltered Massachusetts Bay surface seawater. Bacterioplankton respiration rates, defined as respiration in 0.8- μm filtered seawater, varied from 0.01 to 0.15 mmol C kg^{-1} h^{-1} (0.07 $\pm$ 0.01 μmol C kg^{-1} h^{-1}) (mean $\pm$ 1 SE) and accounted for a high proportion (median 70%) of respiration in unfiltered seawater. Microplankton (unfiltered seawater) respiration rates varied from 0.04 to 0.24 μmol C kg^{-1} h^{-1} (0.12 $\pm$ 0.02 μmol C kg^{-1} h^{-1}). Bacterioplankton growth efficiencies (BGEs), estimated with concurrent measurements of bacterial production and respiration rates, varied from 0 to 69% (median 22%) and were well correlated with specific production rates (r^2 = 0.67). To assess carbon flow in aquatic ecosystems, BGEs should be measured when possible because of their high variability. Compared with bacterioplankton specific production rates, bacterioplankton specific respiration rates were relatively constant (0.05 $\pm$ 0.01 fmol CO_2 $cell^{-1}$ h^{-1}). Given the apparent uncertainty in the values of respiratory quotients (Toolan 1996; Robinson and Williams 1999), carbon-based comparisons of microbial respiration and primary production rates will improve evaluations of the role of the coastal ocean in the global carbon cycle.