THE INTERACTION OF NITRATE AND AMMONIUM. ASSIMILATION BY PHYTOPLANKTON: A STEADY-STATE ANALYSIS

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

IN OCEANOGRAPHY

MAY 1974

By

Paul K. Bienfang

Thesis Committee:

John Caperon, Chairman
S. A. Cattell
K. Gundersen

ABSTRACT

The results of 14 steady-state experiments, representing a wide range of $NH_4^+ : NO_3^-$ regimes, are presented. The investigations utilized nitrogen-limited populations of Dunaliella tertiolecta, growing at rates approaching μ_{max}. The data describe the relationships between the ambient nitrate concentration, phytoplankton biomass, physiological state indicators, and bioassay parameters and the ammonium:nitrate delivery ratio.

The limiting nitrate concentration showed no dependence upon the ammonium : nitrate input ratio. These data indicate that the suppression of nitrate assimilation by ambient ammonium may be produced only by abnormally high limiting nutrient concentrations in batch culture or non-nitrogen limiting conditions in nature. The physiological characteristics, carbon/cell and chl-a/cell were statistically invariant over the range of delivery ratios. At ammonium contributions $\geq$ 24 percent the yield coefficient, q, was inversely proportional ($P = .001$) to the percent ammonium in the incoming media. The linear decline of N/cell and N/C values supports the concept that there is no intracellular reservoir for nitrogen when the limiting source is ammonium-N. Bioassay experiments, involving the transfer of test populations from open to closed culture systems, described a linear relationship ($P = .001$) between q and the resultant population increase.