

**Experimental Evidence for Nutrient Limitation of  
Phytoplankton Growth in Oyster Pond, Falmouth,  
Massachusetts**

**Y. Erlitz**

**S. Fox**

**A. Leschen**

**V. Miller-Sims**

**Boston University Marine Program**

**Marine Biological Laboratory**

**Woods Hole, Massachusetts 02543**

## Abstract

We conducted an enrichment study to determine nutrient limitation of phytoplankton along the salinity gradient of Oyster Pond, Falmouth, MA. The experimental enrichment increased the supply of nitrate, phosphate, and ammonium in the sample bottles. At salinities up to 7‰ enrichment with nitrate and phosphate increased phytoplankton growth. Nitrogen or phosphorus alone did not increase growth at these salinities. In Vineyard Sound (30 ‰) chlorophyll *a* concentration increased in response to nitrate and ammonium additions suggesting nitrogen limitation. Phytoplankton growth in response to nitrate was two times higher than that of ammonium.

## Introduction

In aquatic systems, nitrogen or phosphorus is the most common limiting nutrient since other minerals required for growth may be present in abundance (Ryther and Dunstan 1971; Vince and Valiela 1973; Tomasky et al. 1999). Redfield et al. (1958) proposed that a ratio of nitrogen to phosphorus of 15:1 is required for phytoplankton growth. This ratio can vary considerably; algae exhibit a range of N:P ratios from 5:1 to 15:1 with an average ratio of 10:1 (Ryther and Dunstan 1971). In the surface waters of the sea where photosynthesis rapidly depletes these nutrients, a ratio considerably lower than 15:1 exists, and nitrogen limitation has been observed. Freshwater systems tend to have higher N:P ratios and are limited by phosphorus (Ryther and Dunstan, 1971).

Local studies have demonstrated this difference in nutrient limitation across a salinity gradient. Caraco et al. (1986) and Tomasky et al. (1999) demonstrated that coastal ponds of salinity below 6.5-10‰ in Falmouth were phosphorus limited. A pond with a salinity of 31 ‰ and Vineyard Sound (32‰) were limited by nitrogen. Ponds were both nitrogen and phosphorus limited at intermediate salinities. Since the salinity of Oyster Pond is low (2‰), phytoplankton growth is expected to be limited by phosphorus.

The salinity of Oyster Pond is kept low by means of a weir that controls entry of seawater. Saltwater incursions occasionally occur over the weir with high tides and extreme weather. It is important to know whether these incursions will result in changes in pond salinity, and if so, what implications such changes would have for phytoplankton growth.

Previous attempts to understand nutrient limitation in Oyster Pond have yielded conflicting results. A study conducted in October 2001 found that nutrient enrichments had no effect on phytoplankton growth in Oyster Pond (Doverspike et al. 2001). In contrast, an enrichment study performed in July 2002 found that nitrogen was the limiting nutrient in Oyster

