



## Nitrate – nitrite dynamics and phytoplankton growth: Formulation and experimental evaluation of a dynamic model

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**ABSTRACT:** A multi-nutrient quota model was modified to describe the coupled dynamics of nitrate and nitrite utilization for four phytoplankton species, *Picochlorum atomus* (Butcher) (Chlorophyta), *Nannochloropsis oculata* (Droop) (Ochromphyta), *Isochrysis* sp. (Haptophyta), and *Pyrocystis lunula* (Schütt) (Dinophyta). Although rarely considered in nutrient-limited phytoplankton models, nitrite can be an important nitrogen source, as it can be either released due to incomplete reduction of nitrate or taken up to supplement low nitrogen availability. The model accurately characterizes the dynamics of nitrite uptake and excretion, nitrate uptake and assimilation efficiency, and population growth for the study species in batch culture, despite the fact that the species display a range of qualitatively different nutrient utilization patterns. The good performance of the model suggests that per-capita secretion and re-assimilation of nitrite, together with changes to the per-capita internal nitrogen supply, can be inferred from daily observations of medium nitrate and nitrite utilization and population growth. The model also reproduces qualitative characteristics of nitrite dynamics that have been observed in previous empirical studies, such as a rise in per-capita nitrite secretion when culture medium nitrate concentrations and intracellular nitrogen levels are high. Our model therefore provides a new framework for evaluating the potential broader trophic consequences of the effects of nitrite uptake and release on the dynamics of phytoplankton populations.

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