

Studies on the Kinetics of Uptake of Nitrate
and Ammonia by Phytoplankton
Michael Parker and Ruth A. Pontius
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Swan Lake is an example of a nutrient rich lake (from early summer 1956 until June of this year when a new sewage treatment plant began full scale operation, the north end of Swan Lake received the effluent from a secondary sewage treatment plant at Colter Bay). By comparison, Two Ocean and Jackson Lakes represent nutrient poor lakes. For these reasons the lakes were selected as sites for a study of the uptake kinetics of two nutrients, nitrate and ammonia, in relation to phytoplankton succession in these lakes. Two experiments were also conducted on Jenny and Brooks Lakes.

The kinetics of nitrate and ammonia uptake were studied by adding Nitrogen-15 labeled ammonium chloride and potassium nitrate to samples of lake water. The uptake of Carbon-14 labeled sodium bicarbonate by phytoplankton in lake water samples was also studied at three artificially enriched concentrations of nitrate and ammonia. The Carbon-14 uptake experiments will serve as indices of productivity in the two lakes and it is hoped that they will, by using autoradiographs, provide an additional means of evaluating the assumption that a relationship exists between the kinetics of uptake of nitrate and ammonia and phytoplankton succession.

The basic procedures used in the kinetic experiments are outlined briefly below.

For each kinetic experiment:

1. Routine physical and chemical data was collected from the lake: temperature, light, oxygen, pH, alkalinity, conductivity, Secchi.
2. A representative sample of lake water (approximately 13 gallons) was taken from the study station and brought back to the Research Station.
3. Thirty 1 liter stoppered glass bottles and 22 250 ml stoppered bottles were filled with the lake water containing a mixed population of phytoplankton.
4. Five different concentrations of KN^{15}O_3 were added to 15 of the one liter bottles with triplicates at each concentration. Similarly, 5 concentrations of $\text{N}^{15}\text{H}_4\text{Cl}$ were added to 1 liter bottles. The concentrations of nitrate nitrogen added ranged from $6.15 \mu\text{ gm N/l}$ to $110.7 \mu\text{ gm N/l}$, while ammonia nitrogen

was added in concentrations ranging from 6.28 μ gm N/l to 175.96 μ gm N/l.

5. To each of the 22 smaller bottles, 1.5 μ curies of Ca^{14} sodium bicarbonate were added. Four of these contained only lake water and C^{14} while the rest were enriched with levels of nitrate or ammonia approximately equal to the low, intermediate, and high concentrations used in the N^{15} experiments. Nine bottles (triplicates at each level) were used for study of C^{14} uptake at different nitrate levels and 9 bottles were similarly used to study C^{14} uptake at different ammonia levels.
6. Both the N^{15} and the C^{14} experimental bottles were placed in incubation racks and placed in the Snake River SW of the Research Station. The racks of bottles were placed at a depth which allowed the light intensity striking the bottle to be approximately equal to the light the phytoplankton would have received in the lake being studied.
7. After incubation for 6 to 24 hours, the bottles were removed from the river and brought back to the Research Station lab for future treatment. The bottles with N^{15} labeled phytoplankton were filtered through glass fiber filters for later analysis with a nitrogen analyzer and a mass spectrometer to measure the amount of the labeled compound taken up by the algae. Several samples were taken from each of the C^{14} bottles and millipore filtered for use as an index of productivity. Further subsamples were taken from each C^{14} bottle and filtered for use in making autoradiographs.
8. With each kinetic experiment performed, measurements of the existing levels of nitrate, ammonia, nitrite, and phosphorus were made on samples of lake water brought back to the Research Station at the beginning of the experiment.
9. Samples of lake water (containing the mixed population of phytoplankton being studied) were also preserved for later determination of species composition.

A total of 28 visits were made to lakes from June 7, 1970 to October 4, 1970. Seventeen uptake experiments were performed, although several of these were incomplete since only N^{15} nitrate was employed (Two Ocean, 6; Swan, 5; Jackson, 4; Jenny, 1; Brooks, 1).

The filters collected this summer in kinetic experiments are currently being analyzed. Analysis of all materials from this summer's research should be completed by the end of this academic year. Preliminary analysis of C^{14} filters taken for productivity measurements is currently in progress. Although C^{14} analysis is incomplete, Mrs. Pontius has some indication that there is a different rate of C^{14} uptake with different concentrations of ammonia but not with different concentrations of nitrate.

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