

MAT-WATER PHOSPHORUS EXCHANGE IN AN ACID BOG LAKE¹

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Abstract. The exchange of phosphorus between a bog lake and its surrounding *Sphagnum* mat and the fate of mat phosphorus entering the limnetic zone of a lake were studied by means of a series of mat-labeling experiments using ³²P, and by an analysis of water budgets of the lake and mat.

A ³²P solution applied directly to the *Sphagnum*, so as to simulate phosphorus input from rainfall, produced a labeled soluble but biologically refractory phosphorus fraction which persisted in the lake at the initial concentration level for >16 d. Labeling the interstitial water of the mat directly with ³²P produced a labeled particulate fraction which was biologically active and was quickly concentrated in the limnetic food web. Heavy rainfall flushed both labeled components into the lake.

The pathway phosphorus takes to enter the lake from the mat was determined by temperature gradients in the mat and the degree of decomposition of the mat material. In early spring, with low water temperatures, phosphorus moves along isotherms from the mat directly to the hypolimnion and bypasses the thermocline. In late spring movement is to the epilimnion and thermocline. The maximum phosphorus concentrations in the mat were above a compacted zone at the 2-m depth. This maximum coincided with an open-water phosphorus maximum at 2 m, which indicated that there were frequent inputs of mat phosphorus to this stratum.

The direction of net phosphorus movement was largely controlled by the water balance of the system. During periods of high precipitation, low temperatures, and low evapotranspiration, as was found in early spring, net phosphorus movement was toward the lake. During midsummer high evapotranspiration of the mat vegetation increased the storage capacity of the mat. This reduced phosphorus flow toward the lake so that net flow was often toward the mat.

Key words: atmospheric phosphorus; bog mat; groundwater movement; lake mat exchange; nutrient cycle; phosphorus; *Sphagnum*.