Method for In Situ Measurement of Nitrification in a Stream

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Received for publication 14 August 1974

A method is described in which the oxidation of NH₄⁻N to NO₂⁻N and NO₃⁻N in a stream was measured in situ by use of an equilibration chamber. The conversion was stoichiometric.

Studies of a New York tributary of the Allegheny River consisting essentially of coolant water from a fertilizer manufacturing complex revealed what appeared to be nitrification. This stream receives approximately 11.5 million gallons of heated water per day, averaging 36.8 ± 1.1 °C and carrying about 1 ton of nitrogenous compounds per day. These compounds exist primarily in the form of ammonia and nitrate. The quantity of both nitrite and nitrate increased 140 and 120 kg/day, respectively, with downstream progression. A corresponding reduction in the quantity of ammonia was detected, although the conversion of NH₄⁻N to NO₂⁻N and NO₃⁻N was not stoichiometric. Increases in nitrite and nitrate in natural systems with concomitant, though not necessarily stoichiometric, decreases in reduced nitrogen forms is usually attributed to nitrification (2, 3). Such indirect evidence, however, does not preclude the possibility that extraneous additions of either nitrite or nitrate or the reduction of nitrate to nitrite may have occurred (5). The method described here permits direct measurement of the nitrification process.

With an equilibration chamber, designed for use in situ, we have shown that measurable nitrification takes place over a 4-h period. This retention period was equivalent to the time required for water to traverse the 2.6-mile (ca. 4.18 km) length of the stream. Furthermore, the rate of oxidation seen in the chamber was equivalent to the rate of oxidation occurring in the stream itself, as calculated with upstream-downstream measurements, and required the presence of stream-bottom mud.

The equilibration chamber (Fig. 1) was constructed of marine plywood (0.75 inch [ca. 1.90 cm]) and was divided into three equal compartments with 0.75-inch holes drilled at each end of each compartment to allow water to flow through. Stream-bottom mud was placed in two

[FIG. 1. Equilibration chamber (a) with cut-away view showing placement of stream-bottom mud (b).]
TABLE 1. Changes in the concentration of ammonia, nitrite, and nitrate in the equilibration chamber over a 4-h period*  

| Time (h) | N-form | Conc (mean ± SEM [mg/liter]) | ΔNO₂⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻⁻왜 - 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 워 Webster's New World Dictionary.