

From Acid Dip to Thriving Waters The Impact of Emissions Reductions on Lake Recovery

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Abstract

We develop an optimal control model for the recovery of a representative freshwater lake from acidification. Our objective function is the sum of the disutility from an acidified lake and the cost of emissions abatement by firms. Using emissions as the control variable, the social regulator minimizes the objective function subject to state equations that describe the impact of emissions reductions on the state variables, pH and alkalinity of lake water. We estimate the state equations using a panel data set which monitors the recovery of 43 acidified lakes located in the region surrounding Sudbury, Ontario, Canada over a 24-year period. The results indicate a general upwards trend in both pH and alkalinity, with a decrease in emissions corresponding to an increase in both variables. However, we also find the magnitude of our estimates change as we introduce additional controls, and different assumptions for the specification of acid deposition. This is one of the challenges that must be addressed before our results can be used to solve the control problem for an optimal path of emissions reductions.